

of solid impurity equal to, if not greater than, that in the fine-weather flow; thus there can be no doubt that the lower of these two figures is not in excess of the average. Capt. Calver takes the amount at 100 grains per gallon, and multiplying by the daily discharge quoted as 120 million gallons, he obtains a result of 279,225 tons per annum. This probably does not exceed one-half the true amount, as the water supply of the metropolis alone reaches the amount assumed for the daily discharge, and the rainfall over the drainage area gives nearly an equal amount, which, for the reason just stated, must be taken into account. We thus appear to have at command upwards of half a million tons of suspended matter discharged into the Thames in each year, which is amply sufficient to account for the deposits observed. Thus we read in the report that "Mr. Leach (the engineer of the Thames Conservancy Board) reported in December (1871) that a deposition of 7 feet 9 inches of mud had formed between the upper end of the southern embankment and the White Hart Draw Dock, Lambeth; that another bank 100 feet wide and 6 feet thick occupied the river-frontage of St. Thomas's Hospital, &c. By July of last year a material portion of these masses had been cleared away by excessive rainfalls." Are we to be left to the mercy of such an unpleasant remedy as the floods of last autumn to abate a nuisance of such magnitude, threatening, as it does, the existence of such an institution as St. Thomas's Hospital, and showing how soon we may return to the unsanitary state of affairs that existed twenty-five years ago? We have purposely avoided dealing with an equally important part of Capt. Calver's report, in which he points out the danger of the silting up of the navigable channel of the Thames below London, as he has not shown that the sectional area, though varying from year to year, has at any point permanently diminished, still the destructive elements have been shown to exist, and the forces which now hold them in equilibrium may at any time be thrown out of balance and the evil creep on imperceptibly if once the eyes of the public are closed to its existence. Without going into the question of the value of the sewage estimated by the highest authorities at 1,000,000*l.* per annum, thus not only wasted but employed as a powerful obnoxious agent, enough has been shown from the report before us to, we hope, show the suicidal folly of discharging sewage wholesale and unpurified into tidal rivers. Yet even now a scheme is under consideration for the collection of the sewage from a large area in the Thames Valley and for its discharge into the tidal waters of the Thames. We believe that a careful perusal of Capt. Calver's Report will dispel from the minds of the Thames Valley Joint Board all hopes of a satisfactory though expensive solution of their difficult problem being arrived at in this manner. As a remedy for the state of things he has shown to exist Capt. Calver recommends that in pursuance of the powers they possess the Conservancy Board call upon the Metropolitan Board to dredge away the obstructions they have caused; this may be indispensable at present and may be an unavoidable and constantly recurring expense until some profitable scheme is devised for utilising the metropolitan sewage; in the meanwhile the example of the inhabitants of Abingdon, as shown by the letter of their medical officer of health

in the *Sanitary Record* of November 30, shows the inutility of other towns in the valley of the Thames striving to follow the example of London, and further increasing its difficulties. We learn from Dr. Woodforde's letter that the whole of the sewage of the town of Abingdon is purified by filtration through natural soil being frequently absorbed by one acre of land, and that the amount of organic and inorganic impurity contained in the effluent water after passing through the land is far less, in some cases less than one half that contained in the well water used for drinking purposes in the town. As this unprecedented result has been obtained on land of a character which exists in abundance throughout the Valley of the Thames we think that the towns situated therein have not far to look for the solution of their difficulties.

BOTANY IN GERMANY

Jahrbücher für wissenschaftliche Botanik. Herausgegeben von Dr. A. Pringsheim. Elfter Band. Erstes und Zweites Heft. (Leipzig: W. Engelmann, 1877.)

THE second decade of volumes of the *Jahrbücher* is now begun, and up to the present shows no sign of any falling off from the high standard of excellence attained by the former parts. It is somewhat remarkable that such a work can be carried on successfully. Profusely illustrated (having about 500 plates in the ten vols.), and containing papers of great merit, it is at once evidence of the marvellous botanical activity of the Germans, and the energy of their publishers. A glance at the list of papers in the ten volumes shows that the *Jahrbücher* contain papers that have become classical, and have been contributed by men who have risen to the highest eminence in botanical science. Comparatively few of the papers are contributed by Russians or Italians, hence this one work may be looked on as almost wholly the result of German research. The papers contributed are chiefly morphological and physiological, although occasionally one having immediate bearings on taxonomy is introduced. There can be little doubt that the German university system tends greatly to foster original research, not only in botany, but in all other departments. The botanical institutes, with laboratory, garden, and herbarium attached, the way in which the students are induced not only to learn but to work under the superintendence of the professor, the whole system of private teachers and mode of promotion of the professors fosters research, and gives a thoroughness and heartiness to the work. In certain departments of botany, Britain is second to none with her Hooker, Bentham, and Darwin, but when we consider the enormous "microscope" power of Britain, we cannot help thinking that much of it goes to waste. There must be hundreds of microscopists residing near our coasts, yet what do we know of the reproduction of our algæ? A glance at the "*Botanischer Jahresbericht*" shows how few British botanists there are, and also that each contributes comparatively few papers per year. But quality is better than quantity—work slowly and well. The time is no doubt coming when we may look for increased botanical activity, perhaps the union of botanical studies to medicine has had something to do with the comparative depression, and if botany be-

comes a preliminary instead of a purely professional study by becoming more diffused, a greater taste for the subject may arise.

Prof. Pringsheim contributes the first paper, one part dealing with the interesting subject of the budding of the fruit of mosses, the second on the alternation of generation in the Thallophytes, a subject suggested by the first part. If the seta of the ripe fruit of the moss be cut into pieces, and the pieces cultivated on wet sand, protonema threads will grow from the cut portions, and produce the usual buds, exactly like protonema threads developed from the spores or stem and leaves of mosses. The anatomical connection of the protonema with the tissue of the seta can be observed in good longitudinal sections. Not all the cells can give rise to protonema, but only those of the middle zone, situated between the peripheral cortical cells and the central bundle. These cells contain abundance of reserve matter, such matter being found in many parts of the moss-fruit. The product of protonema by the seta of the moss is to be compared to the budding of the prothallium of ferns described by Farlow. Pringsheim figures in the two plates illustrating the paper, the protonema developing from the seta of *Hypnum serpens*, *H. cupressiforme*, and *Bryum caespitosum*, and he shows the stem and seta to be identical structures.

The second part of the paper, on the alternation of generation in Thallophytes, is difficult to follow without illustrations, as it takes for granted that the reader is acquainted with all the recent researches on the lower plants. Pringsheim distinguishes between sexual alternation of generations and vegetative alternation of generations (sprosswechsel), the fructification and vegetative propagation. All the generations of Thallophytes (as well as of the Cormophytes) begin with one free cell (the spore). The generations in the Thallophytes represent free individual plants, while in the Cormophytes the generations remain in organic connection and in their individual sequence appear only as two portions of one series of developments. From this it follows that the "fruits" of Thallophytes never have the value of a "generation," and also that where the development is due to sexual influence, they are only sexually influenced organs of the female plant. Such parts are the fruits of *Florideæ*, also apparently the Perithecia and Apothecia of Ascomycetes, which do not behave differently from the calyptra of the moss or the thickened tissue (gewebepolster) of the prothallium, in which the embryo of the vascular cryptogams is developed. Pringsheim believes that in the trichogyne and ascogon the influence of fertilisation is spread from cell to cell until it reaches the spores, just as in mosses and ferns the reverse process occurs, and the influence spreads from the fertilised germinal cell to the archegonium. Carpospores and ascospores are therefore to be regarded not as sexually-produced spores of a sexually-produced generation, but as truly sexually-produced spores, developing in the sexually-influenced organ of the mother plant.

The second paper, illustrated by two plates of diagrams, and occupying nearly half the part, is by F. G. Stebler, "Researches on Leaf-growth." The numerous observations made on *Allium Cepa*, *Secale cereale*, *Triticum vulgare*, *Cucurbita melanosperma*, are detailed at full length, and the following summary of the result of the paper is

given at the conclusion. The leaf begins to grow very slowly, then growth becomes more rapid until a maximum of rapidity is reached; then growth becomes slower and slower until at last it ceases. The leaf thus behaves like other growing parts of plants. The growth of the linear monocotyledonous leaf is basipetal. The apex zone of the leaf ceases earliest to grow, then succeeding zones in basipetal order, until lastly the growth of the basal zone terminates the growth of the entire leaf. Most productive of increase in length is the growth in the basal zone, but at different times the maximum activity is in different zones, the absolutely greatest zone of growth proceeding in succession from the upper part of the leaf to the lower. The maximum period of growth of the whole leaf is the sum of the maximum periods of all the zones.

The linear monocotyledonous leaves examined in reference to alternations of growth by day and night showed a daily periodicity of growth, the growth diminishing as the intensity of the light diminishes. The maximum of growth corresponds to the greatest intensity of light; the minimum is observed to occur shortly before sunrise. The cause of the daily periodicity of growth is assimilation; as assimilation increases the growth increases; as it diminishes the growth diminishes.

The same daily periods of growth were observed in etiolated linear monocotyledonous leaves in the dark, the external conditions being constant. The periodicity has thus been transmitted.

In the dicotyledonous leaves observed the daily periods were modified, so that after the maximum of growth was reached in the forenoon a retardation took place, and a gradual diminution of the growth till the following morning before sunrise. At daybreak the growth rapidly increases again to reach a maximum in the forenoon. If the intensity of the light is small the maximum is later of occurring than if the light be very intense.

The maximum of the day periods of growth of the dicotyledonous leaf is due to the assimilation. The retardation during the day occurring after the maximum of growth (but not the maximum of light) has been reached, is due to the action of the light.

The third paper occupying the remainder of the part is by Dr. Celakovsky, and is entitled, "Teratological Contributions to the Morphological Import of the Stamens." It is illustrated by three plates. Considerable uncertainty still exists as to the morphological value of the different parts of the stamen, but more especially of the anther. The difficulty does not exist in regard to the pollen-bearing caulomes, but there are still difficulties in those cases where the stamens are modified leaves. Whether the question can be settled by the study of the development alone is a matter of doubt, even after the valuable researches of Warming and Engler on the subject; and it appears likely that the most important results may be expected from the careful study of the numerous abnormalities of stamens so constantly met with. The scientific study of the teratological developments of stamens must therefore be looked upon as of the highest importance, and Celakovsky—already well known by his teratological researches, here describes and figures the changes (phyllody) of the stamens of *Rosa chinensis*, *Dictamnus albus*, and in the double flower of *Camellia japonica*.

There are two important questions to be answered. 1. Are the pollen-sacs mere enlargements of the leaf-substance of the staminal leaf, or are they special developments somewhat like "emergences"? 2. Do these sacs belong to the under side, upper side, or both sides of the leaf; or are there differences of position in different plants?

Cassini and Roeper held that the pollen-sacs were cavities in the leaf-parenchyma, two forming on each side of the leaf, so that the margin of the leaf corresponded to the suture between the sacs. Mohl considered this view only to hold for certain cases, as the Euphorbiaceæ, and found, what Bischoff had already pointed out, that in all examples examined, as in poppy, rose, and nigella, the four pollen sacs were placed on the *upper* side of the leaf, and that the margin of the leaf ran along the two posterior or lower loculements. Mohl did not consider the sacs as "emergences," and differing morphologically from the true leaf, as he says that the connective represents the central portion of the modified leaf, while the loculements are the thick swollen lateral halves, which become contracted in length and breadth. Mohl considered that in the plants with extrorse anthers both the loculements of each anther lobe were developed on the under side of the leaf. Alexander Braun pointed out in 1851 that the anthers were produced by doubling of the lamina (Ueberspreitung). This view was confirmed by Wydler in 1852, who compared the anther to the abnormal double lamina in the leaf of Bignonia.

Sachs considers the anthers to be appendages of the leaf. He compares each loculement in the anther of Cycads and Cupressineæ to Sporangia; the four pollen-sacs in the Metasperms being "emergences" from the upper side of the leaf, those of the Archisperms from the lower side. Braun still further examined the subject and confirmed his original views, namely, that the pollen-sacs do not belong to a simple leaf, but to one with a double lamina, the doubling due to the formation of an "emergence" (in Karl Schimper's, not in Warming and Sachs' sense). The two upper anther sacs belong to the "emergence," the two posterior to the original lamina of the leaf. Celakovsky in the paper now before us departs from the views published by him in *Flora* for 1874, and fully confirms the views of Braun and Wydler.

The second part of vol. xi. contains five papers by Pfitzer, Koch, Reinke, and Reinsch. Dr. Pfitzer's paper is on the rapidity of the current of water in the plants. It contains an elaborate series of researches, the first on the movement of leaves due to the absorption of water by the stem and root; the second by means of solution of lithium. Dr. McNab's experiments are extended and confirmed, but the astonishing rapidity of 22 metres per hour was observed in *Helianthus annuus*, the greatest rapidity observed by Dr. McNab being 40 inches per hour in *Primus Lauro-cerasus*. Pfitzer also uses a solution of soluble indigo carmine 4 parts to 1,000, and finds that it is superior to solution of lithium, as it can be detected at once instead of using the spectroscope.

The second paper is by Dr. Ludwig Koch, on the development of the seeds of Orobanchaceæ. The development of the anatropal ovule, with one integument is described, and the development of the embryo. This agrees with the description given by Hanstein, of the

embryo of Capsella. The endosperm is formed of divisions of embryo-sac, which contains antipodal vesicles before fertilisation. The third and fourth papers are by Prof. Reinke, both on the development and reproduction of algæ, of the genera Phyllitis, Scytosiphon, Asperococcus, and Bangia, the observations having been made at the Zoological Station at Naples, during the winters of 1875 and 1876.

The last paper is by Reinsch: "Observations on new Saprolegnieæ, on parasites in cells of Desmediceæ, and on the 'Spinous Spheres' in Achyla." A number of new species and genera are described and fully illustrated.

W. R. McNAB

MOVING DIAGRAMS OF MACHINERY

Patent Working Drawings. By H. and T. C. Batchelor (London: Macmillan and Co.)

ALL who are engaged in the teaching of kinematics and of applied mechanics must often have it brought forcibly before them the difficulty that exists in making even comparatively simple mechanical motions intelligible to students by means of ordinary drawings and diagrams, while the more complex motions and combinations can hardly be treated of at all profitably without the aid of working models, which are very expensive, and take up a great deal of space. Again, inventors and the proprietors of patented mechanical inventions, are often at a loss to explain to unscientific or uninitiated persons the advantages of their systems, and costly working models have to be resorted to in order to avoid the mystification which ordinary mechanical drawings often produce in the minds of those not accustomed to them, or who are not versed in the principles of mechanics.

To supply this recognised need of teachers and others, Messrs. H. and T. C. Batchelor have designed and worked out a most ingenious system which combines the mechanical movements of a model with the flatness and clearness of a diagram. The name "Working Drawings" applied to these diagrams is somewhat misleading, especially to engineers and others accustomed to this term as having a distinct and special meaning, namely, drawings made for and used by the workmen employed upon the construction of machinery to work from. Working drawings are essentially drawings for the workshop, and that is the universal acceptance of the word. The meaning attached to it by Messrs. Batchelor is, however, very different; it is drawings which will work moving diagrams. This sense is, perhaps, more critically correct, but as another meaning is the generally accepted one, we cannot but think that it would have been wise if a name had been given to these diagrams more descriptive of what they are. They are, in fact, moving diagrams or sectional working models of machines, the fixed parts being lithographed as a background upon a firm cardboard mount, and the moving parts being also lithographed on card, but cut out and jointed together by most ingenious mechanical contrivances; the whole being no thicker than a sheet of stout cardboard.

The perfection of the centres upon which the various parts revolve or are pivoted together must be seen to be adequately appreciated, for while these centres allow perfect ease of motion to all the parts, they are absolutely